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**Project number – CXP-OC01**

## **The LASC: a New Tool to Monitor Adolescent Smoking**

**An Interactive Qualifying Project Report Submitted to  
Dr. Joseph DiFranza,  
Dept. Family Medicine and Community Health,  
University of Massachusetts, Medical School, Worcester, MA  
and to the Faculty of  
Worcester Polytechnic Institute,  
in partial fulfillment of the  
Bachelors of Science Degree  
by**

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**Sanouri Ursprung (née Fernando)**

**Date: October 11, 2007**

1. Smoking Cessation
2. Adolescents
3. Nicotine Dependence
4. Public Health

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Professor Creighton Peet, Advisor

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Professor Bland Addison, Co-Advisor

## ABSTRACT

This project focused on developing a self-administrable tool, called the Loss of Autonomy over Smoking Checklist (LASC), to measure the onset and progression of nicotine dependence. This was done to provide health professionals with a psychometrically sound tool to detect the onset of autonomy loss over smoking and to tailor cessation programs. Unlike traditional tools, the LASC intentionally excludes socio-cultural factors from the characterization of addiction, making it applicable for use among both adolescents and adults.

## ACKNOWLEDGMENTS

I would like to thank my sponsor Dr. Joseph DiFranza of the University of Massachusetts Medical School for the opportunity to conduct this fascinating research. His patient guidance, support, and funding made this project possible, and his passion for his patients and research inspired me more than I can say. I would also like to extend my thanks to the other UMass staff that helped with this project: to Judy Savegeau for her patience with novice SPSS users, and to Dr. Robert Wellman for his contributions including adult smoking information.

Additionally, I would like to thank Principle Harold Lane, of Wachusett Regional High School, and Principle David Elworthy, of North High School for their cooperation in our research. This project could not have been done without their timely aid and accommodating assistance. Also, I sincerely thank Professor Neil Heffernan for his invaluable assistance in speedily arranging our survey administration at North High School and Sharon DiFranza for acting as a liaison to Wachusett Regional High School. I also thank the participating parents and students of both high schools for giving up their time to help us in our research.

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## EXECUTIVE SUMMARY

According to the Centers for Disease Control, cigarette smoking remains the number one preventable cause of death in the United States, resulting in approximately twenty percent of all deaths annually (CDC, 2006). International standards like the *Diagnostic and Statistical Manual* (DSM IV) (American Psychiatric Association, 1994) and the *International Classification of Disease 10* (ICD 10) (World Health Organization, 1992) only define the most extreme cases of nicotine dependence as “addiction,” and even then define them in terms of socio-cultural contexts, not clinical symptoms. The definitions in these clinical manuals have never been tested in relation to adolescents, nor has much prescriptive research been done on early onset adolescent nicotine addiction. About seventy-five percent of adult daily smokers began smoking before the age of eighteen. Because of the vital nature of this developmental time, identifying and then halting the addiction in adolescents at an early stage is imperative (SAMHSA, 2006). However, few efficient tools or standards have been created to identify the onset and progression of lost autonomy due to nicotine dependence.

My goal was to create a sensitive, personalized, and prescriptive tool to detect the earliest onset of Nicotine Dependence (ND), as defined by a loss of personal autonomy over nicotine consumption, in order to help smoking cessation counselors and medical professionals curb adolescent smoking and treat addiction. To attain this goal, I had four primary objectives. First, I wanted to determine a *non-socio-cultural* based scale of symptoms to accurately characterize the onset and escalation of nicotine related autonomy loss. Secondly, I wanted to confirm that withdrawal symptoms fell into three

separate sub-scales: 1) Psychological Dependence, 2) Cue Induced (situational) Cravings, and 3) Physical Withdrawal Symptoms, as outlined in the *Autonomy Theory of Dependence* (Goldfarb, 2007). Third, I sought to determine the patterns of increasing/decreasing *latency to withdrawal* intervals and their relationship with duration and frequency of lifelong cigarette use, where latency to withdrawal is defined as how long a smoker can go after smoking one cigarette before wanting another.

To accomplish these objectives, I created a 28-item questionnaire that included a 15-item scale of escalating symptoms entitled the *Loss of Autonomy over Smoking Checklist* (LASC). I had it administered comprehensively to the sophomores and juniors at two local high schools. The 15-item scale was made up of three 5-item subscales measuring the withdrawal categories discussed above.

Results showed that our survey had excellent internal reliability ( $\alpha=0.97$ ). The scores on the 15-item scale were strongly correlated with the smoking history of an individual, such as duration of smoking behavior, age of smoking initiation, the volume of cigarettes consumed daily, and the existence of health problems such as ADD/ADHD. Furthermore, compared to other nicotine related survey tools, the LASC measures a wider range of symptoms and collects information on smoking history, which is vital to accurately assessing the progression of autonomy loss over time. All of these findings indicated the achievement of my first objective and showed that the LASC scores do indeed demonstrate an escalation in addiction and autonomy loss.

While I did not discover an order in which the 5-item subscales progressed, I did confirm that they do in fact measure separate aspects of withdrawal, indicating that

different methods of cessation counseling would be necessary depending on the prevalence of a given subscale's symptoms in a patient. Also significant in such tailoring of cessation programs is an ADD/ADHD diagnosis. Subjects with the disorder were twice as likely as those without it, to try cigarettes, and were also twice as likely as non-ADD/ADHD subjects to become regular smokers once having tried cigarettes.

Finally, data showed that contrary to accepted wisdom, the period between latency to withdrawal does not in fact increase as cigarette consumption increases. Instead, our data showed an inverse correlation between intensity of smoking history (including length of smoking behavior, volume of cigarettes consumed per day, and amount of time between cigarettes) and the latency to withdrawal period. This means that early onset smokers can wait longer between cigarettes while still displaying signs of addiction, whereas more experienced smokers need more frequent doses of nicotine. This disproves the theory that the effects of nicotine last only through its metabolization, and indicates that much longer lasting neurological changes must be occurring after nicotine consumption.

The LASC is a unique, psychometrically sound instrument that: (1) measures symptom intensity; (2) can evaluate the resolution of symptoms over time from onset of addiction through extended use; and (3) can independently assess tobacco withdrawal, cue-induced craving and psychological dependence on cigarettes. It does this while also being the first instrument to take into account: age of smoking initiation, lifetime use, smoking frequency, demographic information, cigarette consumption, and history of failed cessation. As such, the LASC is a personalized tool, which equips health

professionals with the information needed to both identify smoking risk factors for preventative measures and tailor cessation programs for current smokers. Because of its sensitive nature and ability to detect even the earliest stages of dependence, it is a valuable asset in combating adolescent smoking both in the US and abroad.



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# I - INTRODUCTION

According to the Centers for Disease Control, cigarette smoking remains the number one preventable cause of death in the United States, resulting in approximately twenty percent of all deaths annually (CDC, 2006). Despite anti-smoking campaigns, massive increases in cigarette costs, and a population wide increase in general knowledge about smoking health risks, annual smoking related deaths have remained at about half a million/year for the past twenty years (CDC, 2002). For each of these deaths an additional twenty people are diagnosed annually with severe smoking related diseases.

The largest age cohort of smokers in the United States today remains those under eighteen. Since 1965, about seventy-five percent of adult daily smokers say that they began smoking before the age of eighteen (SAMHSA, 2006). This suggests that reducing the population of adolescent smokers is the most pressing aspect of nationwide smoking reduction. Since most teen smokers become lifelong addicts, identifying and then halting the addiction at an early stage would be the best way to do this, however no tools or standards have been created to identify the onset and progression of lost autonomy due to Nicotine Dependence.

Because so little research has been done to determine the onset of Nicotine Dependence, smokers often believe they can control their tobacco use until it is too late to prevent addiction. International standards like the *Diagnostic and Statistical Manual* (DSM IV) (American Psychiatric Association, 1994) and the *International Classification of Disease 10* (ICD 10) (World Health Organization, 1992) only define the most extreme cases of nicotine addiction. In reality, most addicts who qualify for such a definition, lost

autonomy over cigarette use *long* before qualifying for the title of “addict”. Previous work shows that addiction can start as early as the first few cigarettes. In addition, much more than societal factors contribute to Nicotine Dependence. Age, gender, socio-economic factors, psychological dependence, physical withdrawal, and situational factors all contribute to cravings and addiction. In order to ascertain the onset of lost autonomy over nicotine consumption, studies must further analyze these many factors.

While many descriptive studies have been done on the effects and causes of teen smoking, very little research has been done to find prescriptive scales to identify and curb the onset of Nicotine Dependence (ND). When studied in youths, cigarette addiction is most often studied in combination with other drugs and alcohol. Also the definition of nicotine addiction is derived from that of adult alcoholism, and relies on similar social criteria, such as societal alienation or vocational trouble, to define addiction. These parameters are not applicable to adolescents, and can mislead teen smokers into believing they have more autonomy over cigarette use than they actually exhibit. Peer groups and adolescent value systems characterize their uptake of smoking in a far different way than adults (Barton et al. 1982; Chassin et al. 1981).

While there has been vague reference to the psychological and social factors influencing adolescent smoking, no scale has been created which measures and identifies these factors (Barton et al. 1982). In addition a majority of research focuses on physical side effects of nicotine, and not the onset/progression of *Nicotine Dependence*.

This study’s goal was to create a sensitive, personalized, and prescriptive tool to detect the earliest onset of Nicotine Dependence (ND) as defined by a loss of personal

autonomy over nicotine consumption, in order to help smoking cessation counselors and medical professionals curb adolescent smoking and treat addiction. To attain this goal, I had four primary objectives. First, I wanted to determine a *non-socio-cultural* based scale of symptoms to accurately characterize the onset and escalation of nicotine related autonomy loss. Second, I wanted to confirm that withdrawal symptoms fell into three separate sub-scales: 1) Psychological Dependence, 2) Cue Induced (situational) Cravings, and 3) Physical Withdrawal Symptoms, as outlined in the *Autonomy Theory of Dependence*. Third, I sought to determine the patterns of increasing/decreasing *latency to withdrawal* intervals and their relationship with duration and frequency of lifetime cigarette use, where latency to withdrawal is defined as how long a smoker can go after smoking one cigarette before wanting another. Finally, my overall goal was to combine all of these elements into an easily administrable, accurate survey tool, which would provide health officials and smoking cessation counselors with a range of information with which they would be able to identify the onset of addiction and then tailor cessation programs for adolescents.

## II – BACKGROUND

Despite the proven fatal consequences of prolonged smoking, research conducted to explore the intricacies of nicotine addiction has not been thorough, leaving the public with conflicting information about the onset, severity, and progression of addiction (eg. Goldfarb, 2007). Moreover, experts in the field dispute the very definition of nicotine addiction. Some even contest the difference between addiction and dependence. For the purposes of this paper, I will use the terms interchangeably. In addition, there are no widely accepted, comprehensive, and psychometrically viable tools to categorize the escalation of nicotine dependence (O’Loughlin et al., 2002b; Colby et al., 2000b). As a result, the diagnosis of “dependence” is derived from subjective clinical interviews, and even then it measures only late stage addiction.

Most research regarding withdrawal at this late stage addiction has focused on the symptoms occurring immediately after nicotine metabolization, without fully exploring nicotine’s complex, lasting after-effects on neurological pathways. Moreover, despite the fact that most adults began smoking during adolescence, research on the progression of adolescent smoking initiation is meager and non-prescriptive. While some observations on the psychological aspects of addiction have been published, there remains almost no research pertaining to the early onset symptoms of addiction.

In seeking to create a prescriptive psychometrically sound tool to measure the progression of addiction, it is important to assess what has been done before. In the following sections, I will review the existing definitions of addiction, describe the



persisting neurological effects of nicotine, discuss the differences between adolescent and adult cigarette uptake behavior, and explain the need for an internationally applicable, psychometrically sound tool for measuring dependence.

## 2.1 DEFINITIONS OF ADDICTION

Conventional wisdom related to smoking addiction comes largely from clinical classifications central to alcoholism as originally laid out by Edwards and Gross (1976). As was later articulated by the authors themselves, even this definition of addiction was created as a provisional description of the condition and not as a comprehensive rule for its identification. From this initial classification however, has stemmed a slew of addiction definitions based more on social contexts and clinical observations than on any formulated clinical theory on addiction (Colby et al., 2000b; Harrison et al., 1998; Rounsaville et al., 1986).

Modern versions of these early “general addiction” definitions are exemplified by the definitions of nicotine addiction in the *American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition* (DSM-IV) (American Psychiatric Association, 1994) and the *International Statistical Classification of Diseases and Health Related Problems, 10<sup>th</sup> revision* (ICD 10) (World Health Organization, 1992) [see Appendices C&D]. Both of these documents describe addiction in terms of social contexts more associated with end stage alcoholism and ignore clinical addiction theory specific to nicotine (Wellman et al., 2006a). For example, the DSM-IV definition of addiction includes the following points: “Time spent in activities necessary to obtain / use

the substance, and recover from its effects [and] important social, occupational, or recreational activities given up or reduced because of use of the substance” (p. 181).

While both of these criteria would indicate a person with nicotine addiction, not all people with nicotine addiction would exhibit these behaviors (Wellman et al., 2006a; Goldfarb, 2007). In fact, the nature of nicotine dependence is such that most life-long smokers are able to continue daily functions without severe interference from their cigarette habit. This is very different from the clinical presentation of alcoholism.

Neither the ICD 10 nor the DSM-IV describe onset level addiction symptoms to indicate when addiction begins. Some studies claim that addiction takes at least two years to begin (Leventhal, & Cleary, 1980; American Psychiatric Association, 1994). The DSM-IV also directly stipulates that dependence and withdrawal begin only after a few years of daily smoking, two factors that have been directly disproven by subsequent studies (eg. DiFranza et al., 2002a; DiFranza et al., 2002b; Wellman et al., 2006; Wheeler et al., 2004). In fact according to the DSM-IV criteria only 50% of daily smokers in their twenties fit the criteria of “addicted” (American Psychiatric Association, 1994). As many studies have indicated, even non-daily smokers exhibit signs of addiction, including failed attempts to quit, when smoking as few as two cigarettes a week (eg. DiFranza et al., 2000; Goldfarb, 2007; DiFranza et al., 2002a; DiFranza et al., 2007; Wheeler et al., 2004). This fact alone makes it highly unlikely that 50% of daily smokers in their twenties have complete autonomy over their smoking habits. These all seem to indicate that the existing definitions, as outlined by the American Psychiatric Association and the World Health Organization are neither comprehensive nor prescriptive. There remains an

urgent need for a sensitive tool to measure increases in nicotine dependence in uptake smokers, before they reach end stages of addiction.

## 2.2. AUTONOMY VS. ADDICTION

As discussed in the previous section, [also see Appendices C & D], the accepted wisdom regarding nicotine addiction categorizes dependence by focusing on late stage symptoms to define addiction. To explore the more subtle aspects of nicotine use, some researchers began looking at the onset of dependence and thereby began re-evaluating the popular definition of nicotine dependence (eg. DiFranza et al., 2002a; O’Loughlin et al., 2002a; Wellman et al., 2005; Wheeler et al., 2004). This conceptual re-evaluation brought with it much criticism from the research community, so, to address these criticisms, those doing the research re-assessed the concept of “dependence” and defined it in terms of a person’s “loss of autonomy” (Goldfarb, 2007). They felt that the most crucial feature of dependence was the loss of personal control over one’s actions and feelings. This *Autonomy Theory of Dependence* moved away from previous definitions that focused on failures to meet social responsibilities and harmful self-detrimental behavior, and thereby became more applicable to a broader spectrum of ages and cultural contexts (eg. American Psychiatric Association, 1994; DiFranza et al., 2000; DiFranza et al., 2002a; Goldfarb, 2007; Wellmen et al., 2006a). These scientists felt that the previously used defining factors of addiction *resulted* from lost autonomy and were not in and of themselves *symptoms* of addiction. Thus finding the onset of “lost autonomy” will allow researchers and health care professionals to evaluate the progression of addiction,

and to work with a wide range of smokers, including adolescents, before their loss of autonomy becomes too severe.

To further categorize lost autonomy, researchers have outlined three psycho-physiological mechanisms by which autonomy can be lost (Goldfarb, 2007). These include: 1) *situational cravings*, elicited by external or internal stimuli 2) *withdrawal symptoms*, elicited by decreased nicotine consumption and 3) *learned psychological dependence*, elicited by negative reinforcement correlating the alleviation of unpleasant physiological states with smoking cigarettes.

Cravings are constant thoughts or responses that are intrusive and persistent when triggered by certain situations and/or stimuli. These could be ritualistic, such as cravings after eating, or triggered by an unpredictable situation, such as seeing others taking a cigarette break. Autonomy is lost when intense cravings continue to intrude on one's thoughts, therein disrupting the ability to function.

The second mechanism by which autonomy can be lost involves physical withdrawal symptoms. Withdrawal symptoms cause loss of autonomy because symptoms such as irritability, stress and inability to focus also diminish one's efficiency and ability to carry out tasks.

In studies involving the "Hooked on Nicotine Checklist," scientists describe the three factors that characterize the final mechanism for lost autonomy, psychological dependence: 1) relying on smoking to cope with stress and boredom 2) relying on smoking for high level performance, and 3) perceived helplessness over cigarettes (eg.

DiFranza et al., 2002a; Goldfarb, 2007; O’Loughlin et al., 2002; Wellman et al., 2005; Wheeler et al., 2004). These factors make up the *Autonomy Theory of Dependence*.

This perceived reliance on cigarettes is an example of negative reinforcement correlating the alleviation of unpleasant physiological states with smoking. For example, smokers generalize the success of cigarettes in removing nicotine-induced anxiety to a need for nicotine to alleviate *any* type of anxiety. Though the two do not have a physiological, causal relationship, psychologically, many smokers believe that they *need* cigarettes to aid them in basic functions, which they were fully able to complete before becoming smokers (Goldfarb, 2007).

Despite the development of the Autonomy Theory of Dependence, only one tool exists to measure how much autonomy an individual has lost. The “Hooked on Nicotine Checklist” (HONC) was developed as a 10-item checklist outlining multiple symptoms of lost autonomy (eg. DiFranza et al., 2002a; DiFranza et al., 2002b; Goldfarb, 2007; O’Loughlin et al., 2002; Wellman et al., 2005; Wheeler et al., 2004). It is a self-administered survey with ten yes/no questions, which is equally viable in adult and adolescent populations (see Appendix C). Any positive answer to a question indicates some loss of autonomy. As scores increase they indicate higher losses of autonomy. Though the HONC was a breakthrough approach at its inception and has continued to have wide use throughout the world, the checklist has only ten items with little prescriptive value for guiding cessation. In addition, it lacks questions regarding age, cigarette volume, demographic information, health, and smoking history to further

illuminate the smoking patterns of each individual. Instead it only acts as a basic indicator of lost autonomy.

The Modified Fagerstrom Tolerance Questionnaire (MFTQ) is another survey tool also widely used among adolescents (see Appendix D) (Fagerstrom & Schnelder, 1989; Prokhorov et al., 1998; Wellman et al., 2006a). It is self-administered, with eight items covering a variety of factors including how many cigarettes were smoked, type of cigarettes smoked, and withdrawal symptoms experienced. However, it remains unclear which aspects of dependence it actually measures. The items on the list correlate to neither the DSM-IV nor the ICD 10 with regard to the definition of dependence, and Fagerstrom offers no alternative theory of dependence. In addition, the questionnaire has an undefined numerical score, that does not correlate to a clearly described aspect of dependence, and it has little predictive or prescriptive value (Colby et al., 2000b; Wellman et al., 2006a). Like the HONC, it too ignores retrospective information and symptom specific information, resulting in a descriptive tool, rather than a prescriptive one. (Fagerstrom & Schnelder, 1989; Prokhorov et al., 2000; Prokhorov et al., 1998; Prokhorov et al., 1996; Wellman et al., 2006a).

There is a wide spectrum of definitions and categorizations regarding nicotine dependence, however there remain no available prescriptive tools to measure the progression of symptoms while providing prescriptive guidance. The autonomy theory of dependence provides a clear definition and a more sensitive focus on the early stages of dependence. However, there still exists a need for a more comprehensive, psychometrically sound tool to assess a wider body of information, and to act as a

prescriptive tool for cessation counselors and medical professionals. In addition, neither the HONC nor the MFTQ provides a scale of progression for symptoms of lost autonomy. The development of such a scale would be invaluable to professionals seeking to discover the severity and onset of lost autonomy while seeking to arrest the progression of symptoms. All of these factors must be addressed before cessation treatments and further studies on adolescent smoking can progress.

### 2.3 LATENCY TO WITHDRAWAL AND THE SENSITIZATION-HOMEOSTASIS THEORY

The advent of addiction is often marked by the onset of “withdrawal” symptoms, yet the nature of withdrawal is under debate. Conventional wisdom holds that withdrawal sets in after prolonged heavy cigarette use (American Psychiatric Association, 1994). This use by definition must exceed the previously discussed standards for addiction, including smoking more than five cigarettes a day (Benowitz et al., 1994; Hendricks et al., 2006). Because the half life of the nicotine in one cigarette is about two hours, it was also believed that as cigarette intake increased, the time needed for the clearance of the drug would proportionately increase, thereby allowing smokers to go longer before withdrawal set in. According to this theory, as individuals smoke more cigarettes they supposedly are able to wait longer between cigarettes. Similarly, this theory would predict that beginner smokers would be able to wait only very short amounts of time between cigarettes before experiencing withdrawal. However, preliminary research seems to suggest just the opposite.

In recent studies on uptake smokers have indicated that withdrawal can begin shortly after they begin smoking (DiFranza et al., 2002a; DiFranza et al., 2002b; DiFranza et al., 2007; Gervais, et al., 2006; Kandel et al., 2006). These symptoms can arise both at levels below five cigarettes a day and before smokers reach the weekly smoking stage. These studies also report that the time elapsed between the last cigarette and when the smoker feels the need to smoke again (known as *latency to withdrawal interval*), *decreases* as cigarette consumption increases. These initial results seem contrary to conventional wisdom. They seem to indicate that withdrawal extends beyond the immediate physical metabolization of nicotine and instead could be triggered by physiological and psychological factors at far longer intervals of latency to withdrawal. Despite these preliminary results though, not enough research has been done to confirm that latency to withdrawal does in fact decrease with increased consumption.

#### 2.4 PERSISTENT AND LASTING NEUROBIOLOGICAL EFFECTS OF NICOTINE

The focus of past nicotine withdrawal studies has been predominantly on the effects that occur immediately after nicotine metabolization, which generally takes 60-90 min (Benowitz, 1988). As a result researchers have largely ignored the potential for cravings to surface after this period has ended and instead have ascribed to the theory that smokers consume nicotine to maintain minimum serum levels to suppress withdrawals (Benowitz et al., 1994). Recent studies have shown, however, that the neurological effects of nicotine extend days and even months after a dose has been administered (eg. Potter et al., 2004; Fernando et al., 2006; DiFranza et al., 2002a; DiFranza et al., 2002b; Wellman et al., 2006b). Both adults and adolescents have reported that smoking one



cigarette can stave off withdrawal symptoms for several days, even weeks. Additionally, one cigarette is enough of a nicotine dose to induce a relapse in ex-smokers (Marlatt et al., 1978). These findings cannot be true if symptoms occur only immediately after the metabolism of nicotine. Recent studies have discovered that nicotine creates extensive changes to neurological pathways, which result in long lasting effects (Collins & Marks, 1991). As a result, it is likely that individuals are addicted at very low levels of nicotine and can experience withdrawal symptoms over long intervals of time.

There are several varying theories on neurobiological reasons for nicotine addiction and withdrawal. Two of the main theories categorizing this phenomenon include the *tolerance-adaptation theory* and the *reinforcement theory*.

The tolerance theory claims that nicotine alters the sensitivity of neuroreceptors in the brain, therein building up a tolerance to the drug over time (eg. Collins & Mark, 1991). The researchers who ascribe to this theory, believe that as this tolerance builds, a cessation of smoking causes withdrawal symptoms proportionate to the average daily dose of nicotine. This is thought to be caused by an adverse over-compensation by the body once nicotine is absent from the system.

Another school of thought ascribes to the reinforcement theory. This claims that once nicotine alters neuroreceptors, it reinforces other neurotransmitter pathways (such as dopamine or endorphin release) and thereby alters the body's perception of certain neurological stages (eg. Frawley, 1998; Potter & Newhouse, 2004). By building this false reinforcement of certain functions of the central nervous system, prolonged nicotine use can influence those activities most closely related to these normal neurological

pathways (eg. increased focus, euphoric sensations, satiation). Studies have indicated that nicotine does increase performance on tests such as the stop signal reaction time measures (SSRT), and many smokers claim that they rely on smoking to perform regular daily tasks (eg. Potter & Newhouse, 2004; DiFranza et al., 2000). Both these quantified and perceived connections between nicotine and performance indicate a connection between nicotine and regular neuro-functioning, and a conditioning to believe that nicotine is necessary for such functioning. Other studies confirm this indicating that smoking changes the functional coordination between components of the working memory neurological pathway, specifically altering neurocircuitry in the parietal and prefrontal lobes of the brain (Jacobsen et al., 2007; Trauth et al., 2001). These changes affect the relevant pathways for extended periods of time and have persisted for over a month in animal studies.

## 2.5 SIGNIFICANCE OF ADOLESCENCE

Adolescence is often viewed as one of the most vulnerable and malleable periods in human development. According to the US Department of Health and Human Services [1994a], 90% of adults begin smoking before the age of seventeen. Because of the significance of adolescent smoking behavior in predicting future adult smoking patterns, I will now review the existing research done on the physiological and psychological reasons for adolescent smoking.

### 2.5.1 Psychological Research

Many reasons have been suggested as to why adolescents begin cigarette use. Some studies claim that adolescents smoke for stress reduction, pleasure, or to self-medicate when faced with stressors (Johnson & Hoffman, 2000; Gallup, 1992; USDHHS, 1994b). Self-medication is also claimed as the reason that twice as many students with ADD/ADHD become smokers after trying cigarettes (Potter et al., 2004). Research suggests that they use nicotine to alleviate symptoms of their disorder. Other studies suggest that cigarette usage projects social values that adolescents perceive as “adult” or “sophisticated” (Klein, 1993). These values include: independence, maturity, defiance of authority, and living in the moment. All of these ideas fall under three main theories of adolescent smoking uptake: *The Social Learning Theory*, *The Strain (or Self Derogation) Theory*, and *The Normative Value Theory*.

The Social Learning Theory claims that smokers and non-smokers both learn their behaviors the same way: by example (Akers, 1977; Bandura, 1986; Hawkins et al., 1992). This theory claims that adolescents become smokers when exposed to parents, peers or siblings that they look up to, who are addicted to nicotine (USDHHS, 1994a). In a recent publication, Johnson and Hoffman (2000) claimed that, for adolescents, imitation, example, and reinforcement are pivotal in shaping future smoking behaviors. While this theory obviously encompasses some of the factors shaping adolescent smoking behaviors, it does not address the role of peer group dynamics or the large population of “good kids” who are not exposed to smoker role models at an early age but begin smoking anyway.

The Self Derogation, or “Strain” Theory, claims that adolescents take up smoking as a way to rebuild their self-esteem once they feel they have failed authority figures that they look up to (Johnson & Hoffman, 2000; Kaplan et al., 1984; Elliot et al., 1989; Jessor, et al., 1991). This theory claims that adolescents who have failed in the eyes of their parents, teachers etc. look for acceptance and respect within an “oppositional sub-culture” (Johnson, 2000 p. 393) made up of other “failures.” Within this culture adolescents revere socially “bad” behaviors as being positive qualities indicating independence and a flouting of social norms and expectations. Jessor (1970) supports this theory stating that this oppositional behavior, or “problem behavior,” is carried out as a assertion of premature adult behavior to intentionally violate age norms. These findings are further confirmed by the findings of McKennell and Bynner (1969) and the work of Chassin et al. (1981) who both describe the image factors most positively associated with smoking in adolescent boys as being toughness and seeming grown up.

Johnson and Hoffman present the increase in adolescent smoking during the 1980’s as proof of the Strain Theory. They state that the increase in awareness over the danger of nicotine consumption, the increase in anti-smoking campaigns, and a decrease in adult smoking indicated heightened social disapproval of smoking. This in turn motivated adolescents with high levels of stress, poor family situations and low academic success to flout social norms by taking up dangerous behaviors (USHHS, 1994a).

The final theory explaining adolescent smoking behaviors is presented in a publication by Ajzen and Fishbein (1970). They claim that the only predictors of a behavior are an individual’s normative beliefs and attitudes. In this theory, external

factors are significant only as they influence these core values. Though other studies support this stance (eg. Chassin et al., 1981), the Normative Value Theory does not address the many social factors and peer interactions that the Strain Theory examines.

From all three of these theories one can extrapolate that the initiation of smoking in adolescents is influenced by significantly different factors from adult smoking initiation, and deserves to be addressed separately. Sadly teen smoking cessation techniques and school counseling protocols minimally identified the factors addressed in these theories. As a result, the few teens who seek cessation help are subject to adult criteria guiding their therapy. For example, the DSM IV, which is a standard in the medical community, classifies nicotine dependence in terms of late stage symptoms and was never tested on or for adolescents (O'Loughlin, 2002; Johnson, 1996; Harrison, 1998; Stanton, 1995). Without a focus on *adolescent specific* factors leading to the onset of nicotine dependence, adolescent smoking cessation programs will never be as effective as they could be.

#### *2.5.2 Neuro-physiological Research*

Though adolescence is known to be a time of great hormonal and neurological change, little research has been done into the specific neurobiological changes in adolescent uptake smokers. In some publications the theories in section 2.3, such as the tolerance-adaptation theory and the reinforcement theory, have been theoretically discussed with regard to adolescents, but no research has been done to identify the neurobiological differences of these theories in adolescents as compared to adults

(Shadel, 2000; Collins et al., 1991). It is commonly accepted wisdom that the brain is most plastic in early development and adolescence, and therein adapts strongly to changes in neurocircuitry (eg. Leventhal, 1980). However, the only studies to address this issue focus on the effects of nicotine on neurological disorders. For example, the connections between cigarette use and ADD/ADHD are but a small body of research done on the effects of nicotine on adolescent neurocircuitry (Potter, 2004; Jacobsen et al, 2007; Trauth et al, 2001). Results in these studies indicate that nicotine has a lasting effect on the parietal and prefrontal lobes of the brain, but little supportive research has been done to unearth, which complex neurological pathways are altered by nicotine.

#### *2.5.3 Approaches to Smoking Education and Cessation*

The factor most hindering the efficacy of most nicotine related survey tools is their lack of utility in smoking cessation. Besides the HONC there is no survey whose score correlates directly with a clearly defined level of addiction, or a specific spectrum of addiction symptoms. Furthermore neither cessation methods nor formal criteria for addiction have been tested specifically for adolescents (O'Loughlin, 2002; Johnson, 1996; Harrison, 1998; Stanton, 1995). Because adolescents represent the largest source of future lifelong smokers, this oversight could have dire repercussions. As a result cessation counselors are left applying the same methods and programs to all smokers regardless of their consumption levels, age, or predisposition to psychological vs. physiological symptoms of addiction. However, by understanding what inspires smokers

to quit and what cessation methods best facilitate success in quitting, researchers can design future research to better tailor cessation programs to each individual.

In exploring why individuals seek to quit, most research converges on three main reasons: 1) factors increasing initial motivation to quit (health concerns, providing a good example, etc.) 2) lower perceptions of stress, and 3) higher levels of self-efficacy (increased self-confidence) (Shuster et al., 1996). To increase motivations to quit in both adolescents and adults, all of these factors must be addressed, however they take on different permutations in different age groups. For example statistical data and warnings of long term health risks have very little effect on changing adolescent smoking behavior (Bandura, 1997).

Adolescent smokers tend to view themselves as “invincible.” They deny health consequences and refuse to personalize long term health risks (Barton, 1982; Chassin, 1981). Even if they conceptually understand long-term health risks, the immediate social benefits of smoking often outweigh the distant consequences (Leventhal 1980). As a result, cessation counselors must appeal to those factors which adolescents value most strongly. These values include positive self-image and a sense of independence (Brehn, 1966; Ross, 1971; McKennell, 1969). Studies indicate that adolescents are far less likely to adopt behaviors perceived as uncontrollable. If they are brought to perceive certain actions as infringing on their psychological freedom, and freedom of choice, they are strongly discouraged from pursuing such activities.

In addition, positive self-image is a strong influence on both starting and quitting smoking. Studies have found that teens are significantly motivated by the perceptions of

those around them (Ennett, 1993; Chen & Yeh, 2006; Newman & Ward, 1989). This includes acceptance by parents, siblings, or peers who smoke. Adolescents adopt the values of those they admire and tend to emulate the behaviors that project their ideal self-image. Researchers found that distancing teen smokers from these values was central to initiating a desire to quit smoking.

Once adolescents desire to quit, many cessation aids are available to them. Counseling, literature, self-help guides, nicotine replacement therapy, and group support programs are all used in varying combinations. Studies have shown that nicotine replacement therapies can almost double the long-term effectiveness of other cessation methods (eg. Simon et al., 2003; Fiore et al., 1994). However counseling as part of multi-component programs is still one of the most effective cessation methods.

Researchers Chen and Yeh, (2006) developed a multi-component smoking program involving lectures about health risks, group discussions about smoking experiences, and role-play to practice skills of relaxation and resisting smoking invitations. Role play was especially effective at developing skills to quit and maintain cessation. After the active counseling stage was completed, Chen and Yeh maintained an online forum where subjects could converse with health professionals and other students to seek support in remaining nicotine free. Since, there is no national “anonymous” program for individuals quitting nicotine like those for alcohol and other abused substances, most individuals must rely on locally organized group therapy sessions. Chen and Yeh’s cyber-alternative could provide a larger group support network tailored specifically for adolescents.



While Chen and Yeh's results were encouraging, most of their subjects had been smoking 2-3 years and smoked over 10 cigarettes a day. This is consistent with clinical standards for nicotine addiction, but does not capture the early stages of cigarette uptake. The study did not differentiate between different levels of cigarette consumption, or different durations of regular smoking. In addition no distinctions were made between perceived psychological and physiological symptoms of addiction. Addressing these important factors could lead to an even more tailored cessation program including other options such as nicotine replacement therapy. However including both self-confidence building therapy and role-playing to develop skills specific to each individual could significantly aid the psychological component of tailored cessation counseling.

Though non-specific to adolescents, a similar study by Ken Resnicow et al. (1997) compared elements of a multi-component cessation program which included: telephone counseling, "Quit and Win" contests, quitting contracts, printed literature, and videos. Surprisingly the largest quitting success rate followed entry in "Quit and Win" contests. This supports the theories, mentioned above, on the initiation of smoking cessation, since contests increase the motivation to begin quitting. Cessation videos depicting the long term risks and strategies for success also contributed to the higher success rates. The least successful cessation method was reading literature and signing a contract. Like the study by Chen and Yeh, this study did not differentiate smokers by age, level of consumption etc., therefore the specificity of treatments was not capitalized. Having a standardized scale measuring addiction could help to tailor which methods would work best on different individuals, and counselors could use this information along

with successful cessation methods to better approach cases on a more individualized basis.

#### *2.5.4 Research Concerns*

When developing studies pertaining to adolescents, other researcher often question the reliability of self-reported surveys. Many other studies have confirmed the external reliability of self-reporting in both adults and adolescents (eg. Wheeler, 2004; Wellman, 2005; DiFranza, 2002a; DiFranza, 2002b; Fagerstrom 1989). This was also confirmed in the development of other tools such as the HONC or the MFTQ, which used follow-up interviews and comparisons to national statistics to confirm accuracy of self-reported data. Furthermore the external reliability of self reported surveys such as the HONC have been validated and implemented by numerous national and international health organizations (Goldfarb, 2007). The HONC itself has been translated in over thirteen languages and is used throughout the world to collect smoking data.

#### *2.5.5 Summary*

Though much research has been done regarding the social reasons for smoking uptake, little research has been done to study the nature of early onset addiction. In fact most research has been largely descriptive. Psychological studies focused mostly on *observing* trends and social structures, rather than finding ways to predict, measure, and arrest cigarette uptake. Additionally, studies creating psychometric tools to measure the uptake of nicotine mostly focused on adult populations, leaving the majority of uptake smokers (adolescents) unscrutinized. Only the development of the HONC involved tests

on adolescents, and though it was a step forward, far more research must be done to create a psychometrically sound scale and prescriptive addiction measurement tool, which is equally effective in adults and adolescents.

## 2.6 SUMMARY

In summary, the field of nicotine-related research is wrought with controversy and inconsistencies, from the very definition of addiction, to its implications on various age groups. There are also many unexplored areas of nicotine research including the complex neurophysiological pathways that continue long after nicotine is metabolized and the differences between adolescent and adult nicotine uptake. However, what cannot be denied, is the significance of studying and stemming adolescent cigarette use as a means of decreasing worldwide levels of nicotine dependence. To do this it is necessary to create an easily administrable, psychometrically sound tool with which to assess growing loss of autonomy over nicotine. This tool must be versatile enough to be used continuously in cessation therapy, or as a one time assessment of addiction. It must be sensitive enough to detect the earliest signs of autonomy loss, yet able to continually monitor even more experienced smokers. In addition, this tool must be far enough removed from socio-cultural factors for it to be used with people in a wide range of ages and backgrounds. Along with this versatility, the tool must measure the psychological, situational and physiological effects of nicotine, to thoroughly assess an individual's dependence on the substance. Finally, this tool must be prescriptive enough to guide cessation counselors and health professionals in monitoring high-risk adolescents and tailoring cessation programs. It is only by studying teen smoking, examining the

mechanisms of addiction and further exploring the effects of nicotine that we will be able to finally overcome the scourge of nicotine addiction.

### III - METHODOLOGY:

There were four primary objectives of this study. First, I wanted to determine a non-socio-cultural based scale of symptoms to accurately define the early onset and escalation of nicotine related autonomy loss. Secondly, I wanted to confirm that withdrawal symptoms can be categorized into three distinct sub-scales: 1) Psychological Dependence, 2) Cue-induced (situational) Cravings, and 3) Physical Withdrawal Symptoms. Third, I sought to determine the patterns of increasing/decreasing latency-to-withdrawal intervals and their relationship with duration and frequency of cigarette use. Finally, my overall goal would be to combine all of these elements into an easily administrable, accurate survey tool, which would provide health officials and smoking cessation counselors with a range of information with which they would be able to tailor cessation programs for adolescents.

#### 3.1 AN EASILY ADMINISTRABLE QUESTIONNAIRE

The primary methodology to carry out this study was an anonymous self-reported survey called the *Loss of Autonomy Smoking Checklist (LASC)* (Appendix A), which I arranged to have comprehensively given to every tenth and eleventh grader at two separate high schools: Wachusett Regional High School in Holden, MA and North High School in Worcester, MA. The survey itself consisted of questions regarding, age, health history, smoking history, current smoking habits, and a 15-item scale. The scale consisted of fifteen aspects of nicotine dependence, which could each be positively

endorsed on a scale of 0-3. To assure a diverse sample, I chose one urban high school with a wide range of minorities and socio-economic strata, along with a more homogenous regional high school serving five rural and suburban districts. I surveyed a total of 1,058 students in all. The LASC was administered as a twenty-eight item Scantron form, which each student filled out independently. High school teachers administered the survey. They read every group of students the same instructions, found in Appendix B. Teachers instructed the students to complete the survey in silence, to prevent influence from their peers. They also ensured that students did not write any identifying personal information on the form to maintain anonymity. In addition, students were reassured that no school faculty would see their answers, and teachers remained at the head of the class while the students completed the questionnaire. This was intended to encourage honest answers through confidentiality and anonymity.

Our purpose was to ascertain the validity of self-reported Nicotine Dependence within high school student populations and to check for consistency between self-assessed addiction with exhibited symptoms. The LASC was designed to contain internal checks to verify consistency. For example, some questions asked students to self-identify a label such as “I am a smoker, but not every day,” or “I have smoked several cigarettes but I don’t smoke now.” These are later followed by questions asking when the individual first began smoking, how many cigarettes a week/day they smoke regularly, and if they have smoked within the past thirty days (Appendix A). All of these follow-up questions confirm whether or not a student is a regular smoker regardless of their self-reported label. Internal checks such as these both verify information and also examine

whether students identify psychological symptoms of addiction as well as physical symptoms. Finally, I individually screened the questionnaires for outlying and bogus responses such as those purporting to be an eighty-two year old high school junior who smokes one hundred cigarettes a day.

Aside from basic information regarding smoking habits and history, the LASC also elicits demographic data including, age, gender, ethnicity, and health history such as ADD or ADHD diagnoses. Also as part of the survey, the survey subjects were asked to report how long after one cigarette they could wait before wanting another cigarette. This period is known as the latency to withdrawal period, and will be discussed further in section 3.4.

### 3.2 THE 15-ITEM SCALE AND 5-ITEM SUB-SCALES

A significant portion of the survey consisted of a 15-item scale, which included three 5-item sub-scales. The fifteen questions were distilled from thirty attributes of smoking addiction, which were selected from previous studies. For example, I examined the previously mentioned Hooked on Nicotine Checklist (HONC), Modified Fagerstrom Tolerance Questionnaire (MFTQ), and other studies for previously examined aspects of addiction such as a tendency to smoke at similar times, around certain people, or in similar situations. I then phrased these characteristics as questions. I separated questions into the three areas of withdrawal as outlined in the *Autonomy Theory of Dependence*. Other researchers then tested the questions on smaller focus groups to ascertain the

effectiveness of phrasing, and the frequency of symptoms. After some deliberation, five final questions were selected in each of the following categories: 1) Cue Induced (situational) Cravings, 2) Physical Withdrawal Symptoms, and 3) Psychological Dependence, as is consistent with the Autonomy Theory of Dependence. (See Appendix A). Subjects could rate how well each question applied to them on a scale of 0-3. The maximum total score was 45, if an individual felt all 15 questions/symptoms described them “very well.” Individual questions will be discussed later in this section.

I designed the questions to identify and potentially separate these three types of symptoms in order to identify the predilections of any given individual, and therein tailor their cessation counseling. For example, sentiments of perceived reliance such as Question 21 (Appendix A) “I rely on smoking to deal with stress,” indicate a psychological dependence, independent from physiological addiction symptoms. Options, like Question 22, “When I go too long without a cigarette I feel nervous or anxious,” identifies a physical withdrawal symptom. We designed these kinds of questions to focus on universal symptoms that intentionally differed from traditional characterizations of dependence such as “My wife left me because of my smoking.” This was done to better address cross-cultural factors of dependence applicable to both adolescents and adults.

### 3.3 A SENSITIVE, TAILORED TOOL FOR CESSATION COUNSELORS

Each element of the survey was created to provide both research data and information to aid smoking counselors and individual smokers in smoking cessation. Fore example, question 4, regarding ethnicity, alerts us to persons of African-American



ethnicity who would experience loss of autonomy at sub-threshold levels of nicotine consumption, because metabolically they need less nicotine in their systems to maintain a given level of dependence. According to current definitions, the threshold for daily smokers is a minimum of five cigarettes per day. However, this would not hold true depending on the genetic variations in individuals and their respective implications on the metabolization of nicotine.

Question 5 is designed to identify the expanding phenomenon of ADD/ADHD patients self-medicating with nicotine to improve concentration. I intended the responses to this question to be used in conjunction with Questions 12, 15, 22, and 23 to help develop ways for counselors to identify this root cause for continued smoking and to guide adolescents to alternative treatments for their disorder.

I also wanted to address preliminary information from previous studies, which indicated that many adolescents have been unable to quit smoking despite falling short of conventional definitions of addiction. A positive response to Question 9, “Have you ever tried quitting but could not” is a clear indicator of lost autonomy and signals to a counselor that the individual needs cessation aids in order to quit. Questions 10-24 are intended to separate symptoms of 1) Situational Cravings, 2) Physical Withdrawal Symptoms, and 3) Psychological Dependence, as outlined in Section 3.2, and to chart their progression in relation to quitting attempts. Counselors could use these categories to suggest alternative coping methods and to explain incorrect perceptions of reliance.

### 3.4 MEASURING LATENCY TO WITHDRAWAL

Latency to withdrawal periods (LTW) measure how long after one cigarette an individual could wait before wanting another cigarette. Questions 25-26 asked students to report this information at the present, and also to recall their latency to withdrawal period as of four months prior. These questions were intended to indicate the escalation of dependence, even at low levels of nicotine consumption. I used the retrospective report of addiction in order to correlate with similar escalations measured in items 10-24, and respective increases in the number of cigarettes consumed as indicated in Question 8. I used these questions because past studies have proven such self-reporting to be reliable. However, though self-reporting is reliable, recall from several months prior has no documented reliability or unreliability. For this reason, the retrospective information was intended as a rough measure to determine if there was a potential need for a future longitudinal study, which would measure the progression of LTW continuously over a span of many months. This sort of data collection could easily be carried out in cessation counseling where individuals have regular meetings, and could even function to indicate a decrease in addiction as individuals try to quit.

### 3.5 MEASURING SCALE VALIDITY AND RELIABILITY

In order to assess the reliability and validity of our proposed scales, we calculated the mean (M), frequency (N), standard deviation (SD) and probability ( $p$ ) for each factor in the questionnaire. We also carried out independent sample tests and t-tests ( $t$ ,  $df$ ) for

Our main focus for the full and condensed scales revolved around questions 10 – 24 in Appendix A. To examine inter-item relatedness, we calculated Pearson's Correlations ( $r$ ), which measures the linear relationship between two variables. The closer Pearson's  $r$  is to 1, the stronger the linear relationship. The closer it is to -1, the less related the items/factors are. We used this test mostly to study the interrelatedness of our 5-item subscales.

We also evaluated Cronbach's Alpha's ( $\alpha$ ) for the 15-item scale and the 5-item subscale to determine the internal reliability of the psychometric scale. Cronbach's Alpha is one of the most widely used, and unbiased tests of internal reliability and covariance. Positive internal reliability is indicated as  $\alpha$  nears 1. This measure indicates whether or not the scale is measuring aspects of a single or related factors, and takes into account the covariances of all items in the scale. If the covariances are equal, then all the items are measuring a single factor. We also used Cronbach's Alpha to determine whether each of the subscales loaded on a single factor, and to determine the increase/decrease in reliability that each item of the 15-item scale contributed to the whole. We did the latter by determining the positive or negative influence of each item by calculating the relative Cronbach Alpha's if deleted from the scale.

To measure the relationship between two rankings, we calculated Kendall's Tau b. This test calculates the agreement between two scores such as the 15-item score and the age of initiation, or between the number of cigarettes smoked/month and the length of latency to withdrawal periods. As Tau nears 1, the two scores have a near perfect correlation, but if they approach -1, then they have a near perfect inverse correlation.

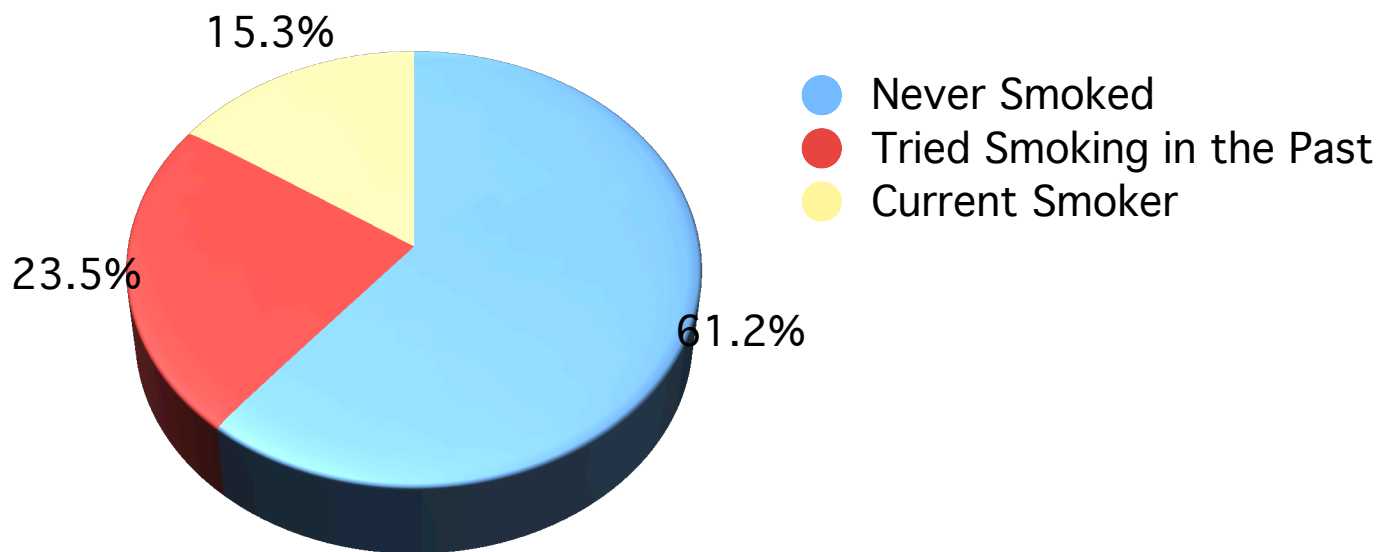
This is especially useful in measuring how other factors relate to LASC sores and latency to withdrawal periods.

We also conducted Levene's Tests for Equality of Variances (F) to measure whether the variances of two items, or two factors are significantly statistically different. If F is greater than 0.05, then the variances are close to equal, and the factors are measuring related things. If F is less than 0.05 then the items are too different and the difference in variance is unacceptable. We used this test to see how scores on the 15-item test correlated with aspects of smoking history, such as duration of cigarette use and age of smoking initiation.

The tests discussed above were selected because of their widespread use in the field of clinical research. They are also the most common tests in the SPSS software package selected to achieve their respective purposes, such as calculating internal reliability, covariance and equality of variance. While other tests may be used in other fields, in addiction research and related scale development these analyses are accepted as being the least biased options and the most statistically reliable.

## IV - RESULTS AND ANALYSIS

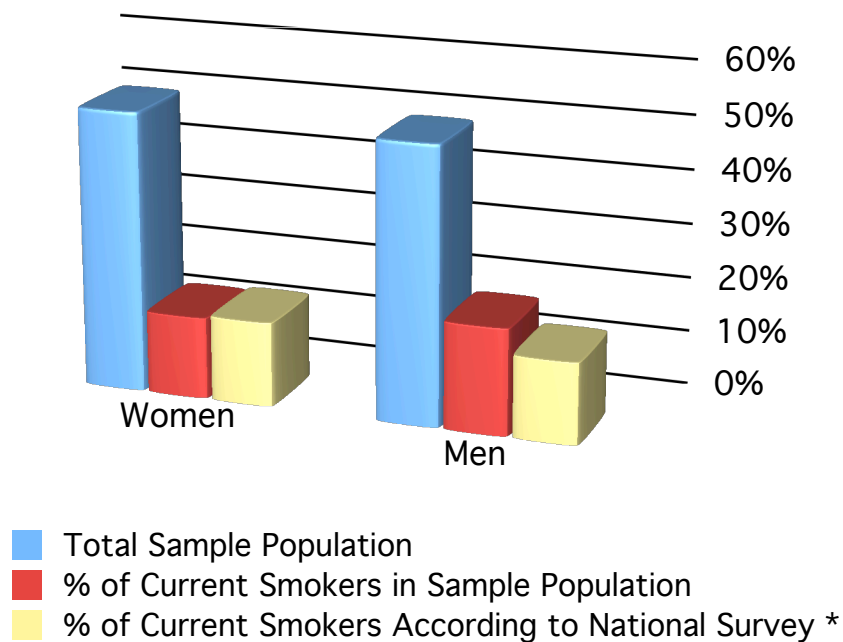
We collected results successfully from both high schools that participated in the study, and combined the data sets to ensure the most diverse range of subjects possible. During data cleaning, we removed 2% of questionnaires due to unreliable information such as ages exceeding 80, and conflicting information such as claiming to have never smoked in one question followed by claiming to smoke 50 cigarettes smoke a day in later questions. This left 1,058 valid questionnaires total. About 61.2% of the subjects had never tried smoking, and 23.5% had tried smoking, but didn't smoke currently (see Figure 4.1). This left a current smoker population of about 15.3%, amounting to about 162 current smokers.



**Figure 4.1 Smoking Behavior Trends in the Sample Population**

#### 4.1 POPULATION CHARACTERISTICS

Of all the subjects, 50.2% identified as female and 49.4% identified as male. The remaining 0.4% failed to provide gender information. About 14.6% of females and 19.0% of males reported being a current smoker, which differed from national data where females tend to smoke more (15.1% as opposed to 14.5% in males) (Johnston et al., 2006). The difference between the national gender related smoking averages and my subject population is shown in Figure 4.2. However, when I compared the responses to



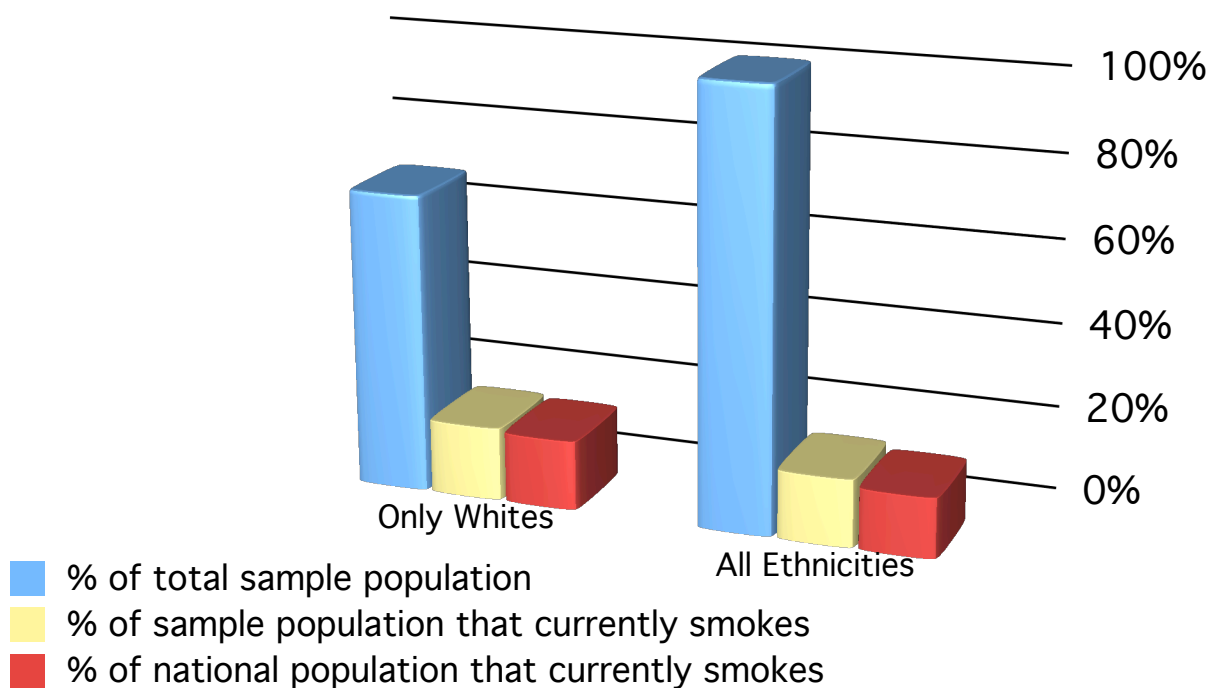
**Figure 4.2 Male and Female Smoking Frequencies Compared to National Data**

\*(Johnston et al, 2006)

individual questions, there was no statistically significant variation in survey responses given by females as opposed to males. One explanation for this discrepancy could be the unusually high numbers of white males in our student population (See Table 4.1 for ethnic demographics), which while representative of the ethnic make up of local

populations, could skew the sample data when compared to national surveys. Future studies with larger populations may discover a gender ratio closer to that of previous research. I did some preliminary statistical analyses on gender differences but found no statistically significant differences based on gender. Positive answers on each item of the 15-item scale were equally distributed between genders. This indicated that gender differences do not have a large part in the *progression* of smoking addiction, but could influence whether an individual is more or less likely to begin smoking.

The average age of participants was 16.9 years old (SD=0.75, Range 16-19 yrs.). Of the 1,058 subjects, 61% had never smoked, 39% had at least tried cigarettes, and 15.3% smoked regularly. Of the regular smokers, about 8% were daily smokers. While close to national data (See Appendix F), these percentages indicated smoking levels



**Figure 4.3 A Comparison of White Smoking Statistics to All Ethnicities in Both the Sample and National Populations**

slightly higher than the national average in both schools (Johnston et al., 2006). One possible reason for this discrepancy could be the differences in our sample's ethnic make up and the national demographics (see Table 4.1, and Figure 4.3). For example, the sample population had half the percentage of African Americans as the national population had. As a result the total population statistics could have been higher than expected because African Americans generally smoke at far lower rates. In fact, the percent of current smokers in the total sample population (15.5%) is closer to the national percentages of white smoking populations (16%) than it is to the national totals (13.8%) (See Table 4.3).

**Table 4.1 - A Comparison of LASC data to National Data regarding under 18 smoking rates in different Ethnicities/Races**

	<i>Am. Indian/ Alaskan.</i>	<i>Asian</i>	<i>African</i>	<i>Hawaiian/ Pacific Isl.</i>	<i>White</i>	<i>Mixed</i>	<i>Hispanic</i>	<i>Total</i>
% of total Sample Population	1.3%	3.7%	7.2%	0.6%	68.7%	8.8%	15.5%	100%
% of Total National Population*	1.0%	4.3%	12.8%	0.2%	66.9%	1.5%	14.4%	100%
% of Sample Population that has ever Tried Smoking	50.0%	30.8%	19.7%	50.0%	41.3%	38.7%	40.9%	39.1%
% of Sample Population that Currently Smokes	35.7%	10.3%	5.3%	33.3%	16.8%	11.8%	15.9%	15.5%
% of US Survey Population that currently smokes**	27.9%	8.1%	7.0%	11.0%	16.0%	—	10.8%	13.8%

\* (USCB, 2000)

\*\* (CDC, 2004)



There were 162 current smokers, of whom 156 provided data that allowed us to calculate their monthly cigarette consumption (mean = 159, S.D. = 0.197, range = 1 - 1176). Of the 162 current smokers, 119 (73.5%) reported a regular need to smoke and a reported some latency to withdrawal period. As previously described, the latency to withdrawal period measures how long after smoking one cigarette one can wait before wanting another. This indicates that these smokers did not have constant cravings, and could sometimes wait prolonged periods before wanting another cigarette. This counters the findings of previous studies (discussed in Chapter 2), which have long held that low volume smokers can last only a very short span before craving another cigarette because their low doses of nicotine are metabolized rapidly. More on this will be discussed in Section 4.4. Current smokers consumed a mean of 203 cigarettes per month. The mean latency to withdrawal period was 65.8 hours (median = 3 hours, range = .05 hours - 504 hours, skewness = 2.53) This mean is far longer than the 2 hours that is currently accepted as the average latency to withdrawal period. This is especially significant because it shows that students can have strong cravings separately by much longer periods of time than thought possible, and can therefore be addicted even if they are not daily smokers.

Racial/ethnic data followed national averages relatively closely. Of the Native American/Alaskan and Hawaiian/Pacific Islander subjects, 50% had tried smoking and 35.7% reported being current smokers. These figures are close to data from the most recent national survey on smoking among different ethnicities/races (See Table 4.1) (CDC, 2004; USCB, 2002). About 41% of the Caucasian student population had tried

smoking. Only 30% of Asians had tried smoking, as had 20% of African Americans.

While most of the minority populations in my sample are too small to extrapolate meaningful conclusions, the statistics remained consistent with national data (See Table 4.1). By including this information in the survey, cessation counselors and school health personnel would be equipped with statistical indicators of future use. For example, Native American individuals have a higher likelihood of continuing smoking behavior once they try cigarettes. About 70% of Native Americans who try cigarettes become life long smokers. This prevalence alone is a statistical risk factor, which can help school health professionals and cessation counselors identify high-risk individuals. In another example, African Americans take longer to metabolize nicotine than Caucasians.

Therefore, an African American student who smokes the same number of cigarettes a day as his Caucasian friend can actually be more addicted than the Caucasian. Also African Americans can be addicted at lower doses of nicotine than other ethnicities/races.

Because of this, counselors could monitor even slight increases in consumption with concern for escalating addiction in high-risk individuals.

Another significant risk factor for counselors to watch, is ADD/ADHD. In the sample population, the percent of students who reported having ADD/ADHD was consistent with national data. About 11.8% of our sample population reported being diagnosed with ADD/ADHD, whereas between 8-10% of students nationally are reported as having the disorder (Johnston, 2006). According to our data, subjects with the disorder were twice as likely to try smoking as non-ADD/ADHD subjects. They were also twice as likely as non-ADD/ADHD subjects to become regular smokers once having tried

cigarettes. Specific odds ratios are outline in Table 4.2. Subjects with ADD/ADHD were also twice as likely to have started smoking before the age of 14, and in general began smoking earlier than did non-ADD/ADHD subjects. This trend is a strong indicator that the LASC data can serve as a predictor of smoking behavior if used longitudinally in school systems. With the information in the LASC, health care professionals can monitor the progression of risk factors, including an ADD/ADHD diagnosis.

**Table 4.2 Smoking Behavior and ADHD**

	<i><b>ADHD</b></i>	<i><b>No ADHD</b></i>	<i><b>Odds Ratio of ADHD vs Not</b></i>
Ever tried smoking	58.5%	35.8%	2.5
% of those who tried that become current smokers	50.0%	36.9%	1.7
% of current smokers that smoke daily	68.6%	46.7%	2.5
Age first smoked a cigarette	13.1	13.7	—
# of Symptoms*	5.2	3.4	—
Average intensity of symptoms* △	1.7	1.5	—
LASC Autonomy Score**	21.3	14.1	—

\* Numbers refer to the 15-item symptom scale within the LASC

△ Each symptom was ranked on an intensity scale of 0-3

\*\* The Autonomy score takes into account both the number of symptoms and their relative intensity.

In their responses subjects with ADD/ADHD also reported gaining pleasure from cigarettes at a higher level than their peers. This, along with the previously mentioned predilections of ADD/ADHD subjects, suggests that neurological differences and/or self-medication practices influence these individual's inclination to take up smoking. With ADD/ADHD students' higher reports of pleasure from nicotine intake, one could infer

that subjects found relief from the symptoms of their disorder through nicotine consumption, and therein derived pleasure from the process. Non-ADD/ADHD subjects did not share this proclivity to report increased pleasure from smoking. Similarly, ADD/ADHD subjects scored consistently higher on the LASC. After performing logistic regressions adjusted for variance of other data (eg. school, race, age), we determined that subjects with ADD/ADHD were 4.8 times as likely to be in the top one third of autonomy loss symptom scores. This is significant for school health professionals and cessation counselors, as the disorder has a clear correlation with nicotine dependence. Identifying the disorder early, and taking into account other risk factors (like race) could significantly assist these medical professionals in counseling ADHD before addiction has set in, and could direct counseling methods toward developing nicotine-free strategies to deal with the symptoms caused by the disease.

Though there were significantly higher LASC scores in ADHD subjects, there was no significant difference in the reporting of each subscale of the scale. Because data were limited, and questions were not designed for primary use as indicators of ADD/ADHD, we cannot fully describe the implications of the disorder on adolescent smokers. However, we did conclude that the disorder can serve as a predictor to alert school health personnel and smoking counselors to a propensity toward adopting regular nicotine use among such students. This in turn, could precipitate intervention at very early stages of addiction in high-risk students.

## 4.2 THE 15 ITEM SCALE

Our 15-item scale displayed excellent internal reliability ( $\alpha=0.97$ ). The scale loaded on a single factor solution where Question 10 (Appendix A), “When I go too long without a cigarette I get impatient,” explained 69% of variance in the other answers on the scale. By this analysis, one can predict higher LASC scores in those who answered this question positively. Table 4.3 shows the 15-items in descending order of frequency and intensity. In general, non-smokers displayed fewer symptoms than those who had

**Table 4.3 Relative LASC Score Averages by Question**

LASC 15-item scale Question (See Appendix A)	Average Score in Current Smokers (max=3)
6. I rely on smoking to take my mind off being bored.	.92
10. When I go too long without a cigarette I lose my temper more easily.	1.07
15. Trying to give up smoking feels like losing a friend.	1.13
5. When I smell cigarette smoke I want a cigarette.	1.30
7. When I go too long without a cigarette I get strong urges to smoke that are hard to get rid of.	1.35
9. I would go crazy if I couldn't smoke.	1.47
2. When I see other people smoking I want a cigarette.	1.57
3. I rely on smoking to focus my attention.	1.82
13. When I go too long without a cigarette I feel nervous or anxious.	1.87
4. When I go too long without a cigarette, thoughts about smoking interrupt my concentration.	1.89
8. After eating I want a cigarette.	1.91
1. When I go too long without a cigarette I get impatient.	1.93
14. When I'm doing something that requires a lot of thought I crave a cigarette.	2.07
12. I rely on smoking to deal with stress.	2.26
11. When I feel stressed I want a cigarette.	2.56

tried smoking. Also, experimental smokers, who do not currently smoke, exhibited fewer symptoms than current smokers, and current smokers had the highest scores. The data showed that the earlier the age of smoking initiation, the higher the LASC scores would be. For example, subjects who began smoking before the age of twelve showed significantly higher scores than those who started smoking later on. Similarly, higher numbers of cigarettes smoked per day, resulted in higher LASC scores. Table 4.4 illustrates this by showing the average scores in different categories of lifetime cigarette

**Table 4.4 Average LASC Scores by Lifetime Cigarette Use**

	<i>Average # of Symptoms Endorsed (Max = 15)</i>	<i>Average Intensity of Symptoms (Max=3)</i>
<b>Never Smoked</b>	0.06	1.31
<b>Puffed a Cigarette once or twice</b>	0.22	1.25
<b>Smoked a Few Cigarettes but Don't Smoke Now</b>	1.53	1.17
<b>Current Non-Daily Smoker</b>	5.49	1.41
<b>Current Daily Smoker</b>	11.26	2.02

use. In another example, students who smoked ten or more cigarettes a day were most likely to score in the top one third of LASC scores. All of these findings confirmed my original hypotheses and indicate that the LASC scores do indeed measure an escalation in addiction and autonomy loss. For example, if the LASC were to be administered in four-month intervals, health professionals could look at the change in LASC scores to indicate if an adolescent's loss of autonomy over smoking has escalated. Even if the individual does not qualify as "addicted," LASC scores could identify the danger of increasing autonomy loss and alert the individual and their health care providers to early onset

addiction. Furthermore, unlike the other smoking related tools discussed in Chapter 2, such as the Modified Fagerstrom Tolerance Questionnaire (MFTQ) and the Hooked on Nicotine Checklist (HONC), the LASC score measures a clearly defined phenomenon, encompasses a wider range of symptoms and collects information on smoking history. All of these elements are vital to accurately assessing the progression of autonomy loss over time.

While the 15-item section of the LASC demonstrated an ability to measure the escalation of addiction in current smokers, it also showed promise in identifying risk factors. Questions 11 and 20 (Appendix A) had a low but significant incidence of positive responses in non-smokers. These could be urges induced by peer pressure and cultural images, and/or they could indicate an early propensity to take up smoking. Only longitudinal studies could confirm these hypotheses, but early indicators could mean that the LASC is the most sensitive tool available, detecting addiction before it fully sets in. The positive selection of these questions could be assessed in conjunction with other risk factors, such as ADHD and ethnicity, to identify students who are at the highest risk of starting smoking and counsel them early.

Other factors in the LASC also acted as indicators of increased addiction. Number of cigarettes and duration of smoking experience correlated with number of symptoms and symptom intensity in current smokers. For example, a subject who smoked fifteen cigarettes a day on average selected more symptoms on the 15-item scale, than a subject who smoked five cigarettes a day. In another example, subjects who smoked a given number of cigarettes for three years displayed more symptoms and higher symptom

intensity than those who smoked the same amount for one year. Non-daily smokers had lower intensities of symptoms, as had those who began smoking more recently. In fact, the LASC score correlated linearly with length of smoking experience ( $F(4, 971) = 992.35, p < .001$ ). Table 4.5 shows the escalating numbers of subjects who endorsed each item. Subjects are divided into five main categories of average lifetime use: “never smoked”, “puffed on a cigarette”, “smoked a few cigarettes in the past but don’t smoke now”, “non-daily current smokers” and “daily current smokers.” Subjects who “puffed on a cigarette” identified as such on the smoking history portion of the survey (See Appendix A) and only took a few drags in their lifetime to present. The next level of subjects identifies as having smoked several cigarettes in the past, but did not take up regular smoking. The two current smoker groups were differentiated based on their reported weekly smoking rates.

Another factor indicating high levels of autonomy loss over smoking was the report of a failed quit attempt. Adolescents who reported having tried and failed to quit, endorsed more symptoms ( $n = 50, M = 9.0$ ) than those who did not ( $n = 190, M = 4.9; t(238) = 5.23, p < .001$ ). Those who had failed a quit attempt also reported a higher average intensity of symptoms ( $n = 46, M = 1.8, SD = 0.5$ ) than those who had not ( $n = 142, M = 1.5, SD = 0.6; t(186) = 2.47, p = .014$ ). All of these factors are significant because they indicate autonomy loss outside of purely volume related definitions of addiction. Because populations have a large degree of variance in the metabolization of nicotine, factors like longer durations of smoking experience or failed quit attempts can



be significant flags to alert healthcare professionals to early addiction even at low levels.

**Table 4.5 Percent of Subjects Who Endorsed Each Item Organized by Lifetime Use**

	<i>Never Smoked</i>	<i>Puffed a Few Times</i>	<i>Smoked a Few Cigarettes But Don't Smoke Now</i>	<i>Non- Daily Current Smoker</i>	<i>Daily Current Smoker</i>
1. When I go too long without a cigarette I get impatient. <sup>W</sup>	0.2%	0.0%	9.2%	46.8%	88%
2. When I see other people smoking I want a cigarette. <sup>C</sup>	2.8%	3.9%	44.0%	82.9%	92.5%
3. I rely on smoking to focus my attention. <sup>P</sup>	0.2%	0.0%	0.0%	14.3%	56.1%
4. When I go too long without a cigarette, thoughts about smoking interrupt my concentration. <sup>W</sup>	0.2%	0.8%	4.6%	29.3%	77.1%
5. When I smell cigarette smoke I want a cigarette. <sup>C</sup>	1.5%	7.9%	28.4%	59.7%	84.3%
6. I rely on smoking to take my mind off being bored. <sup>P</sup>	0.0%	0.8%	12.0%	39.5%	63.9%
7. When I go too long without a cigarette I get strong urges to smoke that are hard to get rid of. <sup>W</sup>	0.0%	0.8%	3.7%	40.3%	84.3%
8. After eating I want a cigarette. <sup>C</sup>	0.0%	0.0%	0.9%	20.8%	83.1%
9. I would go crazy if I couldn't smoke. <sup>P</sup>	0.2%	0.0%	1.8%	23.4%	74.4%
10. When I go too long without a cigarette I lose my temper more easily. <sup>W</sup>	0.0%	0.0%	4.6%	33.8%	83.1%
11. When I feel stressed I want a cigarette. <sup>C</sup>	1.0%	4.7%	34.3%	73.7%	95.1%
12. I rely on smoking to deal with stress. <sup>P</sup>	0.0%	0.8%	15.6%	45.5%	86.7%
13. When I go too long without a cigarette I feel nervous or anxious. <sup>W</sup>	0.0%	0.8%	2.8%	27.6%	72.3%
14. When I'm doing something that requires a lot of thought I crave a cigarette. <sup>C</sup>	0.0%	0.0%	1.9%	24.7%	53.7%
15. Trying to give up smoking feels like losing a friend. <sup>P</sup>	0.5%	0.8%	0.9%	14.3%	43.9%

<sup>C</sup> Cue-induced (situational) Cravings

<sup>P</sup> Psychological Dependence

<sup>W</sup> Physiological Withdrawal Symptoms

For example African Americans, who genetically metabolize nicotine more slowly, may be able to identify early onset autonomy loss, even at low cigarette consumption levels, if they experience a failed quit attempt or have smoked for a long period of time.

We concluded from the item scores, that the 15-item scale could be used in two capacities. It could indicate the level of autonomy lost by acting as a checklist of symptoms, or it could indicate a progression of symptoms over time, acting as a scale. For example, a health care professional who doesn't need a great deal of subtlety, could simply sum the total positive or negative endorsements of the 15-items, to reach a score of 0-15. The presence of the fifteen symptoms in any number, would give the health care provider a snapshot view of an individuals addiction level. On the other hand, if a counselor needs a more sensitive tool, they can consider the intensity of each of the fifteen items in addition to the sum of the total items endorsed. This, more subtle method can also be useful over long periods of time to assess the increase or decrease in addiction. School health personnel or cessation counselors could regularly administer these surveys to monitor the loss of smoking autonomy over a period of time. This versatile longitudinal or one-time application makes the 15-item scale ideal for use in a school or clinic setting.

#### 4.3 5-ITEM SUBSCALES

To create the larger 15-item scale, we initially selected five items from each of three withdrawal subscales: 1) Situational (cue- induced) Cravings, 2) Physical Withdrawal Symptoms, and 3) Symptoms of Psychological Dependence. Our hope was to see a progression between the three subscales, however we saw no indication that any

of the subscales as a whole emerged earlier than the others. We did, however, find that each subscale was a separate entity. Related items in separate scales had different frequencies (See Table 4.5). For example, with regard to the two questions regarding stress, the reported intensity of craving related stress (Question 11, Appendix A) was double that of the psychological dependence related stress question (Question 12, Appendix A). These differentiations and subsequent factor analysis indicated that there is a difference between the scales. The internal validities of the subscales in terms of Cronbach's Alpha and a single analysis of variance are outline in Table 4.6.

**Table 4.6 Internal Validity Statistics for Each 5-item Subscale**

	Cronbach's Alpha ( $\alpha$ )	% Variance Explained by a Single Factor
<i>Cue-Induced Cravings</i>	0.85	63.5%
<i>Physical Withdrawal</i>	0.92	76.0%
<i>Psychological Dependence</i>	0.83	60.7%

The single factor analysis of variance is a test that compares the means of several items in order to identify if the items are correlated. As in this case, the analysis shows that the level of one of the items will allow one to predict the relative levels of other items in the group. For example, given the intensity of one symptom of 5-item physical withdrawal subscale, one can predict a range of intensities for the other four items with 76% accuracy. This measure is intended to show if the scale items all measure related things. Cronbach's Alpha, as discussed in Chapter 3, simply measures the internal reliability and inter-item correlations of each 5-item scale. Pearson Correlations compare two groups of items and indicates whether they are related. For example, I compared each of the

subscales to the other, and found that they are all related. Pearson Correlations indicate interrelatedness as  $r$  nears 1. The Pearson Correlations between the subscales were significant as follows: physical withdrawal and cue-induced craving:  $r = 0.88$ ; physical withdrawal and psychological dependence:  $r = 0.84$ ; cue-induced craving and psychological dependence:  $r = 0.80$ . As all of these numbers are close to 1, we can infer that while they each measure separate symptoms, all the symptoms relate to one condition: nicotine dependence. Though the subscales did not appear to follow a particular progression, the fact that they are separate by nature, can guide cessation counselors and health professionals to tailor cessation methods toward a particular subscale based on the prevalence of certain symptoms.

#### 4.4 LATENCY TO WITHDRAWAL

As postulated, the interval between latency to withdrawal does not increase as cigarette consumption increases, as accepted wisdom has stated. Rather, as cigarette consumption increases, the interval between latency and withdrawal decreases. For example, a smoker who smokes 2 cigarettes a day can go longer before wanting a cigarette than one who smokes 10 cigarettes a day. Of the 162 current smokers, 119 (73.5%) reported a regular need to smoke and a reported latency to withdrawal period (LTW). The mean latency to withdrawal period was 65.8 hours (median = 3 hours, S.D. = 130, range = .05 hours - 504 hours, skewness = 2.53, kurtosis = 5.6). This is far longer than the 2 hour nicotine metabolization half-life widely accepted by the medical community. The fact that subjects experienced strong cravings at such large intervals

suggests that the effects of nicotine must stretch past its metabolization. It also confirms that smokers can become addicted, even at low levels. This is further confirmed by the fact that many of these wide interval smokers have had failed quit attempts, as discussed before.

The data showed that the length of latency to withdrawal also was connected to other factors. For example, LTW correlated inversely with the number of cigarettes smoked per month (Kendall's tau  $b = -.54$ ,  $P < .001$ ). This indicates that a person smoking a pack a day would be able to last a far shorter period of time before wanting a cigarette than one who smoked two cigarettes a day. As intuitive as this may seem to some, it is in fact completely contrary to the current theories on latency to withdrawal. Data also showed that shorter LTW's were associated with higher withdrawal scores on the 15-item scale (Kendall's tau  $b = -.45$ ,  $P < .001$ ) and a younger age of smoking initiation (Kendall's tau  $b = .26$ ,  $P < .001$ ). This confirms that longer-term smokers experience withdrawal more acutely than uptake smokers. Similarly, more infrequent smokers experience much longer LTW periods, lasting sometimes weeks before experiencing cravings. This confirms the preliminary findings of a study on adult intermittent smokers, which discovered a segment of adults who smoked only a few times a month, but found themselves unable to quit (Fernando et al., 2006).

While my sample data on past cigarette use was an approximate measure based on retrospectively collected information, the clear inverse trend between LTW and duration of smoking indicates that a more specific scale relating length of smoking experience to LTW does exist. Future interview-based longitudinal studies may be able to better assess

the exact numerical relationship between these factors, which would better predict the progress of nicotine dependence. Administrations of the LASC every four months, for example, would provide more reliable data on the progression of LTW length than one-time retrospective data collection. This kind of study may bring forth data that better predicts the shortening of an individual's LTW for any given increase in cigarette consumption. For example, hypothetically, we may be able to predict that an adolescent who increases his/her consumption by two daily cigarettes every month will find their LTW period decreased by 2 hours in six months. These kinds of predictions can alert adolescents to the rapid nature of addiction, and could equip cessation counselors with predictive tools to aid them.

## V - CONCLUSIONS AND RECOMMENDATIONS

In completing this study I was able to successfully achieve all my initial objectives. The data suggest that the Loss of Autonomy Smoking Checklist (LASC) is a successful tool for measuring a wide spectrum of symptoms starting at the onset of addiction, while also providing health care professionals with a range of pertinent information to help them tailor cessation programs to each individual. Some unique advantages of this new instrument are that it (1) measures symptom intensity; (2) can evaluate the resolution of symptoms over time from onset of addiction through extended use; and (3) can independently assess tobacco withdrawal, cue-induced craving and psychological dependence on cigarettes. It does this while also being the first instrument to take into account: age of smoking initiation, length of use, smoking frequency, demographic information, cigarette consumption, and the history of failed cessation. Additionally, in creating this tool I have successfully proven that, contrary to previous assumptions, the period from latency to withdrawal does not increase with prolonged use, but rather distinctly *decreases*.

When compared to previous tools such as the Hooked on Nicotine Checklist (HONC) and the Modified Fagerstrom Tolerance Questionnaire (MFTQ), the LASC obtains a much wider range of information. It measures length of cigarette use, smoking frequency, the progression of symptoms over time, amounts of cigarettes consumed, predictors of smoking behavior (including ethnicity, ADD/ADHD, etc.), smoking history, quitting history, and symptom history. All of these factors make the LASC a far more

specialized tool which provides a rich array of information for the tailoring of cessation programs.

The 15 item scale is another element of the LASC which makes it especially versatile. The survey can give a smoker or a cessation counselor a snapshot idea of autonomy loss if given once. However, it can also monitor both positive and negative progress by indicating an escalation or decrease in symptoms and symptom intensity over time when administered longitudinally. No other accepted nicotine scale has this ability.

The prevalence of a 5-item subscale within the 15-item scale, could also alert health professionals to an individual's propensity to gravitate toward a particular type of addiction/withdrawal such as: 1) *Psychological Dependence*, 2) *Cue-induced* (situational) *Cravings*, and 3) *Physical Withdrawal Symptoms*. Each of these subgroups would suggest different treatment methods. For example, a preponderance of psychological dependence symptoms would suggest that counseling could be a more effective method, whereas a majority of physiological withdrawal symptoms could indicate nicotine replacement therapy as a more useful option.

The discovery that shorter latency to withdrawal periods are associated with prolonged use, high consumption rates, higher smoking frequency and higher LASC scores, alerts health professionals to the fact that more frequent urges to smoke indicate higher loss of autonomy over smoking. This is completely contrary to current perceptions regarding nicotine addiction, which indicate that higher volume smokers should be able to wait longer between cigarettes because it takes longer for large amounts of nicotine to be metabolized. Aside from overturning this widely held belief, this



discovery also signals the progression of autonomy loss over cigarette consumption and therein aids cessation counselors and other health professionals in identifying increased dependence on nicotine. This study attempted to take rudimentary measurement of such progression by collecting retrospective data. While in survey form the collection of retrospective data has unknown reliability, in interview format, recall has been proven effective. However, in its present form, this tool could be used as either a first time assessment tool for cessation counselors or as a longitudinal tool for prolonged counseling, for future use I would suggest that retrospective data collection be replaced with reassessment at periodic intervals to ensure maximum validity.

The ease and versatility with which it can be administered is another factor, which lends the LASC to widespread application. It can serve as a data collection tool for additional research, or as a cessation tool in addiction counseling and preventative care. In the latter capacity, the LASC demonstrated even more versatility in its ability to be self-administered. As such, not only can it be given in person, but it can also be administered virtually in electronic support groups and counseling sessions. E-counseling was shown as a successful treatment method among adolescents in the research of Chen and Yeh (2006). In fact their peer support groups were more successful online than in person. For internet based programs like Chen and Yeh's, the LASC could aid counselors who cannot individually interview adolescents in person. The ease with which the information can be ascertained could serve as an efficient tool for these kinds of programs. However, this does not make it any less effective as an in-person tool for one-on-one counseling.

The predictive qualities of the LASC make it especially suited to treat nicotine addiction at preventative and early onset stages. Most of the predictive abilities of the LASC rely the identification of risk factors related to demographic and personal history information. For example because in certain groups, such as Native Americans, smokers make up 50% of the population, counselors can be hyper-vigilant with individuals who exhibit mild symptoms of lost autonomy over nicotine, even at low consumption rates. Similarly, cessation counselors and school health personnel could preventatively counsel students with ADD/ADHD, to find alternative methods of focusing their attention and could alert the students to their increased risk for addiction. With the ethnicity/race data collected, counselors could caution African American students that they are far more susceptible to losing autonomy over cigarette use at a given consumption level than their Caucasian peers who smoke the same amount. Any individual with a failed quit attempt or prolonged use history would immediately be at a high risk of being dependent on nicotine. This is confirmed by the data, which clearly indicates higher LASC scores in individuals with previous failed quit attempts and in individuals with longer histories of smoking. Because the LASC identifies all of these risk factors, health professionals who use it would be far better equipped in implementing preventative care programs and early onset treatments.

While I am secure in the effectiveness and reliability of the LASC, I would suggest that future longitudinal studies verify certain elements of our research. First, the predictive and sensitive nature of the LASC is vital to its success as a tool for early onset detection, however a few items on the scale had some incidence in non-smokers. These

included Question 10, “When I see other people smoking I want a cigarette” and Question 20, “When I feel stressed I want a cigarette.” While the incidence of these symptoms was very low, future longitudinal studies could determine whether this incidence is a predictor of future use. Also, longitudinal studies could verify whether subjects can accurately recall the retrospectively collected data, such as the latency to withdrawal information in Question 26. This could either validate the effectiveness of the current format, or indicate a need for periodic administrations of the LASC to determine the progression of symptoms.

The current wording of the LASC lacks specificity in determining the history of smoking behaviors. While it asks when the individual had their first cigarette, it does not specify exactly how long the subject had been smoking regularly. In future studies I would suggest that one of two measures be taken to better ascertain this information. First one could change the question to inquire at what age the subject began smoking at least once a month, though this could decrease the sensitivity of the tool with regard to detecting early onset nicotine addiction. The alternative could be asking subjects to proffer their total lifetime consumption such as 1-2 cig, 3-5 cig, 6-20 cig, 20-50 cig, 50-100 cig, or 100+ cig. This would indicate the degree of lifetime use in relation to the duration.

I would also suggest that more research be done regarding ADD/ADHD and adolescent smoking. While this study determined some interesting preliminary data, such as a doubled likelihood of ADD/ADHD subjects to both try and continue smoking, further research must be done to determine the causes of these statistics. I suggest

questions such as family smoking history and a checklist of potential reasons for smoking to further elucidate the connection between nicotine and this widespread problem.

Finally, I would recommend more research be done regarding the psychological motivations behind adolescent smoking behaviors. The LASC asks only five questions regarding psychological aspects of addiction, however it is likely that many more factors influence an adolescent's decision to smoke. While primarily peer group influences and rebellion have been blamed in the past, more studies on self-image (such as cigarettes as a method of diet control) and advertising could illuminate more psychological misconceptions, which cessation counselors could then address to better help youth smokers.

Aside from these recommendations this preliminary study, has resulted in the successful attainment of the initial objectives. The LASC is a sensitive, prescriptive tool with the capability to detect early stages of nicotine related autonomy loss. It separates and identifies the three areas of withdrawal as outlined by the autonomy theory of dependence, including 1) Psychological Dependence, 2) Cue-Induced (situational) Cravings, and 3) Physical Withdrawal Symptoms. Also, the LASC data set confirmed the inverse relationship between cigarette consumption and the length of latency to withdrawal periods, thereby countering conventional theories. Finally, the LASC is a personalized tool which equips health professionals with the information needed to both identify smoking risk factors for preventative measures and tailor cessation programs for current smokers. Because of its sensitive nature, and ability to detect even the earliest

stages of dependence, it is a valuable asset in combating adolescent smoking both in the US and abroad.

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